Canal Zone Notes
Book #4

U. S. GEOLOGICAL SURVEY

GEOLOGIC BRANCH

LOOSE-LEAF FIELD NOTEBOOK

Canal Zone Notes
Book # 4

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Friday

June 14/12 — [illegible] up Trinidad River headquarters at [illegible] ½ mile [illegible] [illegible]

[illegible] at 7.30 [illegible]

[illegible]

[illegible]

Some [illegible] for conglomerate beds in the clay

Sat June 16 [illegible] up [illegible]
Went up right hand branch
of river Rio Sein, to new
observation station, say 3 mile
above junction, is about on
sand, here first [illegible]
[illegible]
Gabis clays, [illegible] with some
sandy beds. almost horizontal
[illegible] ridge
up to 75 [illegible]
[illegible]
[illegible] 400 [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
The [illegible]
hard, fine grained [illegible]
[illegible]
[illegible]
[illegible] on the top of the
highest hills [illegible]
75 feet above [illegible]
[illegible]
[illegible]

It may be that these 75 foot hills represent a peneplain In fact it looks that way. and it may be that these pebbles are the more resistant residue of the conglomerate pebbles worked over by the peneplanation processes.

Esquaval is a hill which rises 100 or more above the present level of the river. It is a typical Banana river sandstone with some light grayish more clayey beds, no limestone on its top.

About 5 miles down river in a straight line below Esquaval I climbed hill 75 feet above present level of lake (27.6' above sea level) and found same clayey sandstone and some pebbles. Sandy Gatun formation

Junction of Chagres (or old French Canal) & Trinidad river. Good exposure of light gray & yellow clay & clayey sandstone. upper Gatun on south side Hill about 100 feet above sea level

Shift ahead some pages

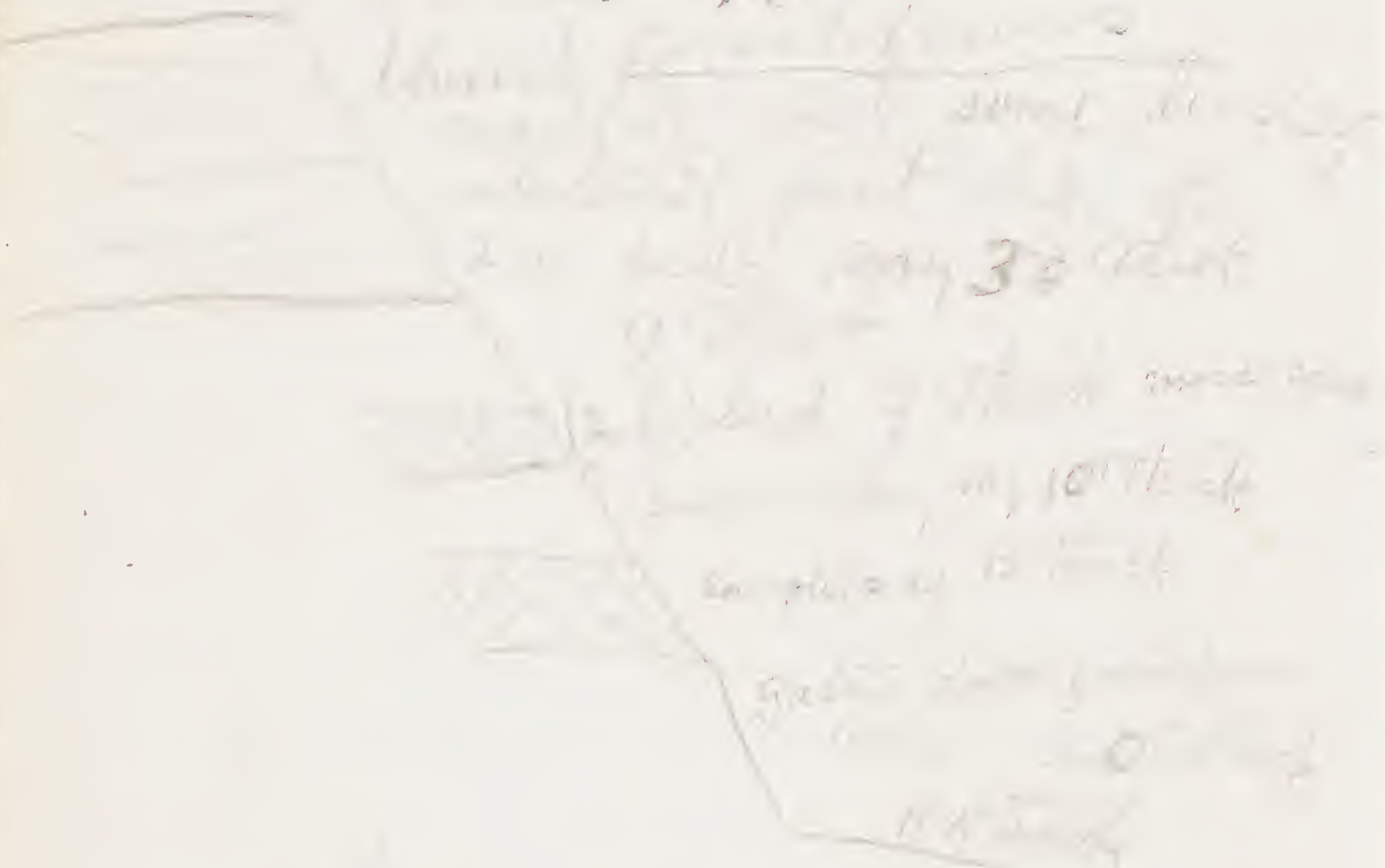
Venado Island is chiefly gray limestone locally much iron stained and brecciated. Locally this limestone seems to be rather pure but considerable areas of it are metamorphosed, sheared, ~~[illegible]~~ hydrothermally altered and replaced. It is just about the same thing found on Taboga.

fullers earth

section in cut where
sample 2a & 2b came
from

[illegible] fine [illegible] [illegible]

16 [illegible]



Bank probably not more
than [illegible] [illegible] [illegible]
[illegible]

fullers earth near gate

(1) Sample [illegible] [illegible] [illegible]
9 feet thick
(1) [illegible]

(2) (a) [illegible] bed 12 feet thick [illegible]
[illegible]
~~[illegible]~~ [illegible]
[illegible]

(2)(b) top bed 9 feet thick and
[illegible]
[illegible]
[illegible]
[illegible]

fossil bed see section
at 2 where fullers
earth sample (2) came from
[illegible]
[illegible]
[illegible]

above them.

St #3 Sample #3 is yellowish
[illegible] light brown and [illegible] is
buff in color. It looks not
nearly as good as samples
#1 & #2, because there are
some clayey lumps and [illegible]
[illegible]
[illegible] place the
clayey material [illegible]
[illegible]
[illegible]
[illegible]
[illegible] perhaps [illegible]

St #4 Sample #4 [illegible]
very good material [illegible]
white [illegible]
of [illegible]
about 9' of [illegible] exposed
at the top of the cut bank

St #5 Fairly good buff [illegible]
[illegible] few white spots
[illegible] about 9' [illegible]
[illegible]

St #6 2 9 foot pit of
fresh, pure looking clay
with very few light spots
but worked (as in [illegible]
cores) with 30 to 35 % water
to a very good "[illegible]"
consistency which may be
a very little weak for
potter's wheel?

St #7 2 foot — Slattery's house
about 12 ft of light colored
material lighter, [illegible]
and more powdery than
all the other samples. It
contains a large proportion
of the material which makes
the white spots in the
other samples. This
stuff may be too poor
for potter's wheel.

June 21st — Oct 5

islands in [illegible] Bay and along other coastal [illegible].

Changamwe islands are hematite [illegible] formation. This formation is a [illegible] colored coarse [illegible] which flakes [illegible] with the [illegible]. [illegible] streaks and [illegible] of red hematite and [illegible] of brown [illegible] with the [illegible]. The [illegible] in this [illegible] matrix [illegible] altered [illegible] and some of [illegible] like flow [illegible] at [illegible] in [illegible] be [illegible] some [illegible] looking [illegible] occurs quite locally which may be part of [illegible] dike.

[illegible] dikes [illegible]. There appears [illegible] irregular quartz and calcite stringers and ~~tw~~ small fine local breccias

Tortola Isl.
Tortolita Isl.

The next island (Tortolita) towards Chorrera is a rather greenish lava agglomerate with angular fragments of dark hard fine grained lava (see spec 337/77) with some large and small irregular masses of hematite breccia cutting it. From the shape of these hematite breccia masses it looks as though they might represent highly altered basic dikes cutting the other material. Some of these hematite breccias on this island are very fine in texture (see spec

Tortola Isl.

The next island (Tortola) a few hundred yards from the above island is the coarse hematite breccia somewhat similar to that of the Changarmi islands. However in this case the matr

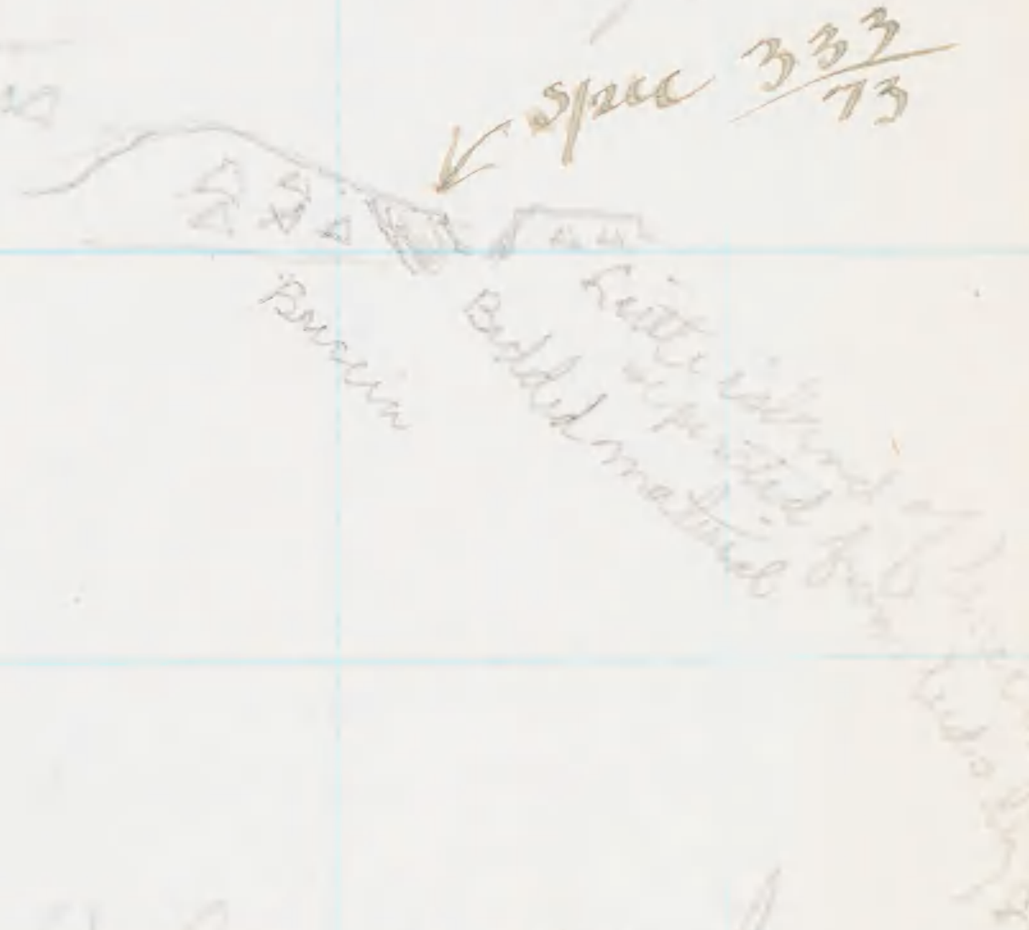
Spec. 337/77

Test these samples for
(1) Phosphates
(2) Glauconites
(3) Calcite
(4) Dolomite

---

is somewhat dark greenish-brown and the large & small irregular fragments are more brown hematite color. This matrix gives the impression that it might largely be a replaced glauconitic limestone.

Toward one end of this island a dike like or possibly a bed of altered greenish material cuts through breccia thus



For Venados Island see back several pages

The next little island ½ mile towards Taboga from Venados seems like all gray limestone

[illegible] of rock
dry little gray, limestone
which has a pattern like the
dendrite, and the lighter part
in this case was the calcite.
On closer inspection I find that
the rock is a highly altered
quartz bearing diorite or
basalt (see specimens)

Sample # 331

Volcanic island is a most
peculiar formation. It consists
of basalt? which shows a very
greenish ~~[illegible]~~ weathered
surface. It is divided into
columnar structure, and
with the columns perpendicular
to the surface of the sea and
from 1-2 feet in diameter.
Some of these columns [illegible]
but at good many places have
been [illegible] [illegible] rather
suppressed. There is a most
distinct horizontal cleavage
which is very marked [illegible]
and which divides the rock
into layers of from 2"-18" [illegible]
Then there is a small
secondary cleavage more or
less parallel to the main
cleavage but varies
somewhat from it. The
secondary cleavage is from ½ to
2 inches apart. The main
cleavage [illegible]

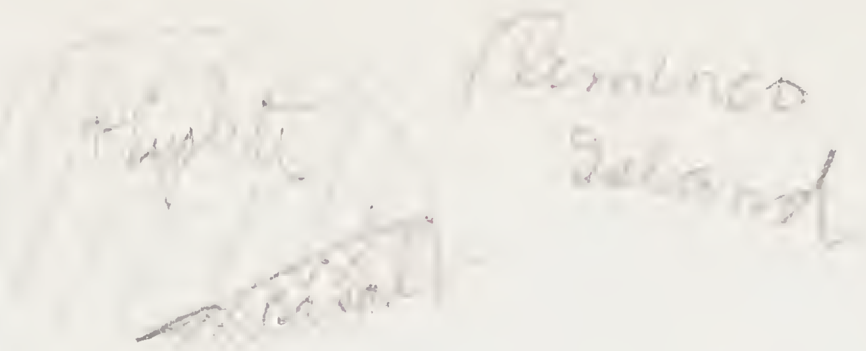
locally and is clearly brought out only where etched by the waves (see pictures) This cleavage system is wonderfully distinct and regular where where etched and for a time I that the material was meta limestone (see spec)

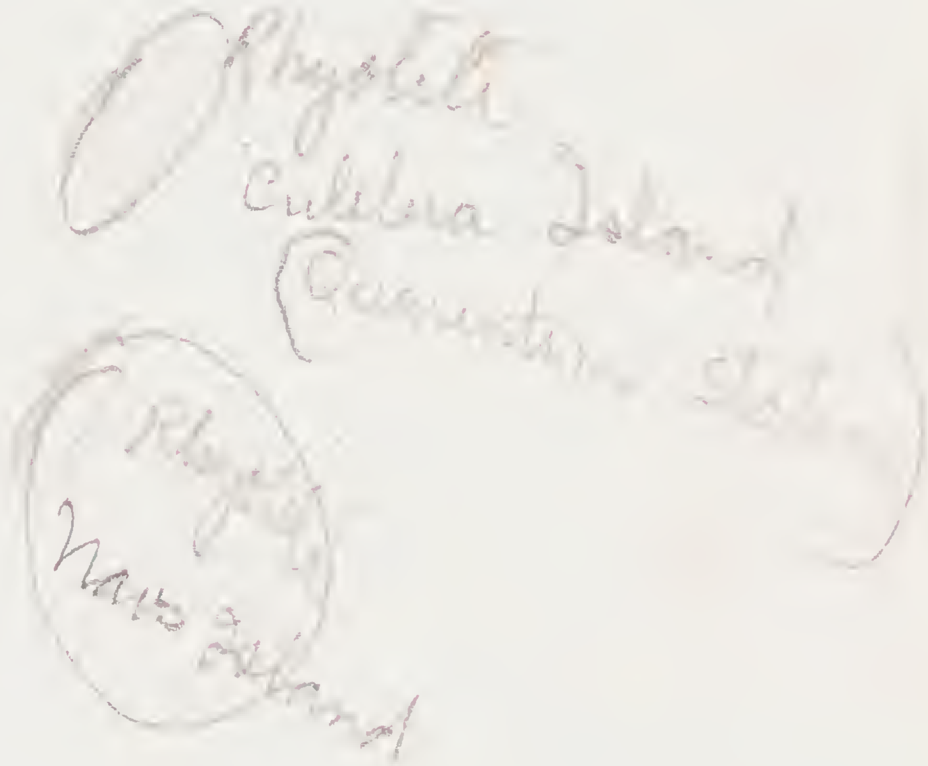
The weathering has proceeded from the jointing inward and very locally some hydrothermal action along joints seems to have taken place.

Bruja point on mainland near Venados island is same peculiar Coarse breccia Locally quite limy and in places much stained by hematite It is also bedded plainly in places This is certainly the same formation of the islands of Panama Bay west some exceptions (as Melone &c) It seems to be the same formation that one finds right through to old Panama (see spec)

Point Batite. Seems to be all basalt? But a second* light greenish brown variety has intruded the darker brown variety This area of basalt is rather extensive and it is probably one of the many basalt masses which cut through this and the sedimentary formations clear back beyond the divide towards Bohio

*Spec 334/74





Flamenco Island Aug 20
with Prof Kemp

This island presents a 45° slope to the ocean southward [illegible] a 30° slope northward. The north edge is [illegible]. The cap top and south end is rhyolite [illegible] Ancon Hill. The [illegible] is much shattered not closely spaced parallel [illegible] and some jointing [illegible] angles [illegible] near top [illegible] [illegible] and [illegible] in [illegible] [illegible] [illegible] [illegible]

Find basalt dike & fissure cutting this rhyolite dike S 30 W 70°

Tahrgellia Island

Southern side find good beach 1/8 mile long sandy & gentle slope. On E. end are what look like massive red limy tuffs. with some angular fragments of dark basaltic looking rock. This red rock gives some little indication of bedding and shows specks and small white crystals of calcite. (See specs)

On the west end of beach (S side island) same dark ropy flow or bedded?) meta tuffs. Black basaltic or ~~ans~~ iron stone looking irregular junks in them and the whole shows a most streaked metamorphosed appearance. (see spec) same as at Changarmi island.

(1914)

Aug 21st ([illegible] said

Big slide occurred Aug 20 on east side cut north of Empire

North end at 1648

South end of slide [illegible] by thick [illegible] [illegible] by [illegible] with [illegible]

75 to 80 feet

S side of [illegible] about 1554

August 24/1912 Notes on Gold Hill

The core part of Gold hill shows disturbed bedding which dips away from the large peripheral dike at from 90° close to the dike to 60° in the hill farther

Where the dike parallels the canal the bedded material is very similar to beds in the upper part of the green clay formation in front of the old Hotel Culebra or the lower part of the limy sandstone series (specs) 1/8/24 and 2/8/24

In the main front face of Gold Hill about 85 feet below the basalt cap there is a dark coarse well bedded tuff made up of 25% of bombs from the size of grains of wheat to say 2½ inches in diameter with a few larger (3/8/24) These beds dip away from the dike [illegible] at about 65° So far don't remember having seen anything just like this but there are beds in it of mottled gray tuff such as found N of Pedro Miguel

Dark beds at south end of this level might well be bedded clays below limy sandstones

The above bomb beds are unconformable on other dark gray sandstone and mottled tuff beds which dip 50° S E

30 feet below the basalt there is a

flows say 30 feet of dark gray
fine grained rock which [illegible]
Spec the few tiny crystals perhaps
hornblend basalt 4/8/24
This flow is separated from [illegible]
of the basalt by about 10
feet of [illegible] scoria or [illegible]
[illegible]
[illegible]
[illegible]
Spec [illegible]
Spec 6/8/24 [illegible]
[illegible]
Spec 6/8/24 spec of [illegible]
[illegible] of [illegible]
Spec 7/8/24 spec banded tuff
south end of [illegible]
[illegible]
[illegible]
[illegible]

To Old Panama Aug 24/12
On Savanna road at
Juan Diaz $3\frac{3}{4}$ miles out or so
find some good looking
clay beds similar Fullers
Earth beds. These are local
however. They seem to be locally
on top of basic tuffs &c.

$\frac{1}{4}$ mile along shore from old Panama
along here coarse volcanic breccia
some coarse very basic fragments
& some soft coarse ashy
lenses

$\frac{1}{3}$ mile along find small area of coqu
say 75 sq yds 1 to 2 feet thick on
agglomerate. Is this due to lime
water cementing the shell sand
same as on ~~[illegible] to the~~ Flamenco
& other island? probably

Basic dike trends N.W. and
forms 2nd point from old
Panama coarse material as
previous sample & spe 1/8/25

2/8/[illegible] shows basic tuff lies in coarse basic breccia which continues right along from Old Panama

The formation along the Pacific coast of the canal zone is a peculiar one. It consists essentially of bedded tuffs locally of acid character ~~at least locally~~, interbedded with coarse volcanic agglomerates and breccias ~~and~~ ~~with basic tuffs.~~ the fragments of which are mostly basic These beds are cut by dikes mostly large and nearly all of basic character (see specimens already gathered) It would be extremely difficult in fact locally impossible to map these dikes and would result in no particular advantage The uppermost of these tuffs seem to be acid as shown near Panama but any separate maping of them seems impossible at present.

Trip to Pearl Islands. Arrived San Miguel Sunday Sept 1st 1912

Opp San Miguel

strike N60E Dip N 25 to 30° almost north of it find great series of well bedded dark bluish shale with sandy layers ~~all~~ the whole well laminated.

Picture

weathers somewhat sandy and brownish gray in color. Thought I detected some things like ~~[illegible]~~ foraminifera. 14

Specimens 2 to 6 or so lbs #5

Cutting this shale I found some

Spec 5 basic dikes (2) rather coarse grained and showing some greenish mineral probably secondary chlorite. These dikes ~~[illegible]~~ caused contact metamorphism to a distance of 3 to almost 5 feet. They trend almost northwest and southeast. and are 10 to 15 feet wide.

North end of Peninsula, opp San Miguel is igneous rock [illegible]

Rest Island Position

#1 shows building the edge
of shore up. Sea [illegible]
also [illegible] [illegible] of [illegible].

2 shows [illegible] [illegible] two yrs
[illegible] #1, [illegible] [illegible]
Spec #5 and [illegible] [illegible]
[illegible] [illegible]

It seems that [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
rapidly. [illegible] [illegible] [illegible]
forms [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]

Spec 9 shows [illegible]

Spec 10 shows [illegible] [illegible]
[illegible] about ½ and
Sediment [illegible] [illegible]
just across) [illegible] from
peninsula where [illegible]
[illegible] [illegible]

A [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] Spec 11 [illegible]
[illegible] the [illegible] [illegible] [illegible]

would bring them under the
rocks of the [illegible] where
[illegible] first [illegible]

Sunday morning [illegible]
Sabuga island [illegible]
[illegible] N 70 W 2.5

Spec 12 groups of [illegible]
13 [illegible]
well [illegible] almost [illegible]
itself [illegible] [illegible]
[illegible] and many [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible] unconformity with the [illegible]
[illegible]

On [illegible] [illegible] points
[illegible]
[illegible]
[illegible] the [illegible]
[illegible]
[illegible] perhaps
[illegible]
[illegible]

of about some [illegible]
[illegible] as [illegible] [illegible]
and [illegible] [illegible] [illegible]
[illegible] still [illegible]
Spec 14

~~Met comm [illegible] [illegible] [illegible]~~
~~[illegible] [illegible] [illegible] [illegible]~~
~~of [illegible] [illegible] in paper~~
~~[illegible] [illegible] [illegible]~~
~~[illegible]~~

Panorama from top of
Hill "Basalt Peak" located on
opp page Seeing from north
to left towards south

(1) shows Pienzo almost to
Cerro Gordo shows part of Empire
through valley

(2) Shows Cerro Gordo and old
looking even sky line topography
to left of it up to and well
past peculiar flat cone
on horizon

(3) From just S of flat cone to
and including big high smooth
rounded mountain west
of Balboa towards Arraijan

(4) Shows big smooth outlined
mountain & islands in
Panama bay

Monday Sept 8th
Out with Surveyor Hall to
Caimito River Camp

From top of Basalt peak get
the following sights on triangulation
points

(1) N 18 W
(2) to Pienzo N 68 W
(3) to Cerro Gorda N 96 W
4 to Cerro Cocoli → S 38½ W
5 to " Caimitillo S 21½ E

The above located peak is a very
steep basaltic plug so steep that there
are large exposures of basalt
without any vegetation off
toward (1) are two lower but
fairly steep hills which are
like savannahs devoid of
vegetation toward Cerro Gorda
and a butte to the left of it,
towards Chorrera, the topography
looks smoother and older
The islands out in panama
bay are certainly merely ~~the~~ part of

similar region with the higher
parts still above water. Scrubby
in places) [illegible] [illegible] Ones
[illegible] [illegible] a old [illegible]
of about [illegible] [illegible] [illegible]
are around as there is a fair
game of [illegible] they. The river
water (cattails) is a [illegible]
ever-lasting meandering
[illegible] [illegible] [illegible] [illegible]
thing a [illegible] [illegible]
certain [illegible] [illegible]
[illegible] [illegible] the [illegible]
[illegible] [illegible]

Tuesday Sept 17th

went out to Juan Venus river with Mr. Johnson

note that brecciated material used for macadamizing roads all out to old Panama is breccia not very different from Contractors Hill material spec

On top of this are clayey shales almost like Fullers earth beds spec

Limestone outcrop at Rio Tapia is certainly the usual looking material found at intervals across Isthmus dip about 10° E specs

about [illegible] S [illegible]
[illegible]
along Little Creek and
the [illegible] old [illegible]
as [illegible]. The [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] rock on [illegible]
[illegible]
[illegible] (Porphyry
[illegible]

[illegible] many feet [illegible]
old [illegible] some coarse [illegible]
spec which carries black [illegible]
[illegible] rock which [illegible]
of augite spec

Sunday Sept 19 Out
[illegible] west [illegible]

Point [illegible] is very hard
[illegible] grained [illegible]
the comparatively [illegible]
Coarse [illegible] found all [illegible]
[illegible] thin bands [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible]

Spec 1/19/12 . [illegible] from Pt [illegible]

Point Fairfax. Basaltic [illegible]
seems to be similar to that at
Madison Island Have not
[illegible] any [illegible]
[illegible] features noticed
as at Madison Island

Spec 2/19/12 shows the [illegible]
basalt [illegible] for [illegible]
[illegible]

Spec 3/19/12 [illegible]
[illegible] [illegible]
[illegible]

the narrow strip must have been punched up & left when dikes came up & both side split

Diorite dike from cor. Cocoa Island. Big outcrop all around this point. Probably basalt — diorite probably from same magma as Ancon Hill Clay cut by basalts.

Spec 4/19/12 diorite

At nose of point [illegible] & Balboa [illegible] find shaggy dike & [illegible] contact with diorite see spec 5/15/12 [illegible] [illegible] [illegible]

(1) [illegible] [illegible] in [illegible]

(2) Mud stone beds

(3) yellow gray [illegible]
sandy beds

Sept 20 [illegible] [illegible]
from [illegible] [illegible] to [illegible]
[illegible] [illegible]
(1) [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible]

(2) [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] Pen [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]

Fred & I [illegible] hill with [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]

[illegible]
away [illegible] the [illegible]
[illegible]. There are [illegible]
[illegible]
I [illegible]
the [illegible]
[illegible]
along.

School left at [illegible]. [illegible]
is all [illegible] but [illegible] the
main [illegible]
[illegible] with [illegible] — [illegible]
[illegible]
[illegible] and [illegible]
up [illegible] I might almost
be [illegible] a small [illegible]
of [illegible]
[illegible]
[illegible]
and spectator [illegible]
[illegible]
[illegible] of [illegible]

[illegible] [illegible] [illegible] [illegible]
that the [illegible] [illegible]
a [illegible] [illegible]

(9) [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible]

[illegible] 7/19/12 Morning
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] work

[illegible]

[illegible]

[illegible]

[illegible]

Quarry near old Panama
rc

Sept 24th Trip from ~~Pedro Miguel~~ Corozal to Arrajan

The first ~~say~~ Mile out from Corozal find comparatively coarse breccia or almost conglomerate The fragments are mostly coarse grained and largely decayed They are not basaltic but must be much older probably corresponding in age, and very probably the same thing as the breccia out toward Old Panama

Beyond that find basalt breccia practically all the way to Arrajan. This consists of small and large angular pieces of hard fine grained basalt embedded in yellowish weathering tuffaceous material This formation must be about the same yes —

Later dikes & intrusions

Are these conglomerates or agglomerates really basaltic as is Gold Hill &c or are the fragments older rhyolitic rocks?

as the Empire Office Hill & Paraiso breccias.

Locally there are some masses of coarse gabbros probably dikes similar to those which form savannas? all over this country.

In one or two places the trail seemed to pass over patches of yellow weathering sandstone but the evidence was not clear because the whole formation might be referred to the coarse agglomerate, with sandy beds, found all along the Pacific Coast from Old Panama to Panama &c

On the whole the formation between Corozal & Arraijan should be mapped as the coarse note Is the pitted surface of the basalt on Cerro Gorda due to wind driven sand action? Did this take place when the lower land was submerged? Are there two ages of basalt? If not the basalt fragments in the bedded tuffs must denote that they are ~~[illegible]~~ much younger than the limestone!

breccia + tuff beds of the old Panama – Panama Coast.

The topography between Corozal and Arraijan is comparatively flat. This may be due to a former submergence. In fact there is topographic suggestion ~~of~~ that Cerro Gordo Cobre and the high land near them were islands before Gold Hill and other high points were pushed up. There is some black rich soil in the low swampy places along the way but in all other places there is red soil with hard angular basalt fragments scattered through it.

Are the majority of these fragments of this composition or different

Sept 25 Out from Arrajan with Hill towards Coblere

(1) First station on Cocli divide where Hill set up instrument in the morning (see map)

Spec 1/25/Sept shows basalt(?) rather grayish (or is this Ancon Hill rhyolite) which shows as fragments, large and angular, all along here. Some of these are 2' to 3' in diameter. It would be impossible to tell whether there is a dike of this material here or whether these fragments are only those of a matrix of tuff and tuffaceous breccia, a Paraiso breccia

After hunting several hundred yds in this vicinity and examining many specs I find that this rhyolitic rock is the only kind represented (see spec 1/25/Sept)

These rhyolitic ~~formation~~ fragments continue beyond stream (tiny) crossing

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This rhyolitic rock shows peculiarly regular "laminated" flow structure on weathered surface

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Just at this very small stream (dry in dry season) and on Cresty ridge n. of it find breccia of which the matrix seems to be this rhyolitic rock and the fragments older coarser and more basic rock. However the whole is much weathered and the fragments especially seem much decayed. ~~all~~ ~~around~~ on both sides of these very small outcrops are good fresh fragments of rhyolitic rock.

Right up to top of high peak ascended for Colore find same rhyolite showing good flow structure. Some of this structure is at a comparatively steep angle on the hillside as if due to upward flow of viscous rhyolitic lava. On top the flow structure is locally

Locally near Arrajan are some pieces of coarse basic gabbros as well as rhyolitic fragments and some pieces of basalt. The variety probably comes from dikes

where observed almost horizontal On the very top is a comparatively small area of breccia, which appears to be similar to that at quarry near Old Panama as if carried upward by intrusion of the rhyolite! This high hill then is due to rhyolitic intrusion

From here (triangulation station Cobre) looking off towards the N.W. see a great broad flat country clear up to the Trinidad mountains. There are many little rolling hummocks but no elevations which seem to be more than 4 to 5 hundred feet This seems to continue almost clear across the Isthmus with perhaps higher land N. of the Trinidad river

On trip out took La Boca trail find this rhyolitic rock down into deep gulch not far N.E. of Colon ridge. Same rock continues up over another high ridge crossed by trail. Near foot of that ridge or pretty well down find coarse gabbro and some tuffaceous looking rock to west of it (towards Arraijan) However in general on both sides of it find rhyolitic rock. so it seems to be big basic dike cutting rhyolitic material or at least light gray colored fine grained rock which shows flow structure. More evenly crystallized here however spec 6/24/ Sub

than elsewhere but this is not more than 500 feet of that. The zone of intrusive topography begins at about the west border of the Canal Zone and continues eastward. The peculiar — cone shaped mountain is one of the Trinidad group. This flat region was probably submerged until a late geological date. S E the country out to the coast is flat and contains savannas except the high basalt ridges opp. Naos & La Boca. Pearl Islands show in the general S Easterly direction. This △ st shows some breccia just as found locally through here, otherwise all rhyolite

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Henry Bigot

when I got down into the flat bottom land 2 feet 100 feet beyond where spec (6/20/sept) came from which was 200 above the bottom lands find a series of tuffs ~~[illegible]~~ locally meta; also lava flows and breccia mostly tuff-agglom'd reddish [illegible] some local stringers of quartz and rusty cavities locally In general the harder fragments are [illegible] in the bottom and some are cherty. This whole flat must belong to the old meta-tuff-chert [illegible] series of some of the islands ~ Panama Bay. This whole flat must have been submerged at a late geological time. There are a few low hills in the flat and they are basic or

rhyolitic dikes or necks and thus meta-tuff. surroundings

The last two miles I came in a canoe through a mangrove tide swamp. which should be so mapped